

**WHAT IS CLAIMED IS:**

1. Apparatus for leak detection, comprising:

a sealable chamber configured to receive a test piece that, while in the chamber, contains a trace gas;

5 a trace gas permeable member mounted in gas communication with the chamber; and

a trace gas sensor comprising an ion pump in gas communication with the permeable member and configured to sense trace gas that passed from the chamber through the permeable member, the sealable chamber being isolated from gas communication with a vacuum pumping device other than the trace gas sensor.

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2. Apparatus as defined in claim 1, wherein the permeable member comprises a quartz member.

3. Apparatus as defined in claim 1, wherein the permeable member comprises a quartz

15 member, the apparatus further comprising a heating element in thermal contact with the quartz member and a heater controller configured to control the heating element.

4. Apparatus as defined in claim 1, wherein the permeable member comprises a polymer member.

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5. Apparatus as defined in claim 1, wherein a trace gas permeability of the permeable member is controllable.

6. Apparatus as defined in claim 1, wherein the permeable member is permeable to helium.

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7. Apparatus as defined in claim 1, wherein the trace gas sensor includes means for sensing the trace gas at a specified time after the test piece containing the trace gas is placed in the chamber.

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8. Apparatus as defined in claim 1, further comprising a housing enclosing the permeable member and the trace gas sensor, and a vacuum flange for attaching the housing to the chamber.

## Substitute Pages

9. A method for leak detection, comprising:

providing a sealable chamber, a trace gas permeable member in gas communication with the chamber and a trace gas sensor comprising an ion pump in gas communication with the permeable member, wherein the sealable chamber is isolated from gas communication with a vacuum pumping device other than the trace gas sensor;

placing in the chamber a test piece that, while in the chamber, contains a trace gas;

passing the trace gas from the chamber through the permeable member; and

sensing the trace gas with the trace gas sensor.

10. The method as defined in claim 9, wherein the permeable member comprises a quartz member.

11. The method as defined in claim 9, wherein the permeable member comprises a quartz member, the method further comprising heating the quartz member.

12. The method as defined in claim 9, wherein the permeable member comprises a polymer member.

13. The method as defined in claim 9, wherein the permeable member is permeable to helium.

14. The method as defined in claim 9, wherein passing the trace gas through the permeable member comprises controlling trace gas permeability of the permeable member.

15. The method as defined in claim 14, wherein controlling trace gas permeability of the permeable member comprises controlling sensitivity of leak detection.

16. The method as defined in claim 14, wherein controlling trace gas permeability of the permeable member comprises controlling temperature of the permeable member.

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17. The method as defined in claim 9, wherein sensing the trace gas comprises sensing helium.

18. The method as defined in claim 9, wherein sensing the trace gas comprises sensing the  
5 trace gas at a specified time after the test piece containing the trace gas is placed in the chamber.